

talk about them or solve them, but whoever attempts the last will find that no science yet known, no steam-power, and no number of millions the coffers of England can supply, will meet the difficulty here presented by a foot of flat ceiling.

Well, as the ceiling-surfaces and vents, then, are the only engines which can keep the required current in motion throughout the building, and as their prime mover is of limited power, not only is their form and structure all-important, but so is the avoidance of all needless obstruction to their work, or to the exit of the air already above them, which is only passively expelled by their agency. Now, the descending-pipes added by "D." would offer it a most needless resistance by their mere length, supposing them, of course, to have an area at least equalling that of all the ceiling-vents, which would require them to be far larger or more numerous than any rain-pipes.

3dly. But I have shown (in the appendix to the work quoted) that wherever there is a chimney and fire fed from the room, the chimney is the only available final outlet. Any other passages, as the pipes proposed, would become inlets. So that, as the chimney must be the general foul-air outlet in winter, there is no reason why it should not continue so in summer. A change to rows of wall-outlets between the ceiling and roof, or ceiling and floor above it, would certainly be preferable, because the higher the external temperature, the weaker becomes the self-ventilative power, and the less resistance should be opposed to it. But this refinement might be left to superior buildings.

4thly. As to the objection of "D." against "cold carbonic acid pouring out" of apertures on the faces of the building, and infecting the air about to be drawn in, he forgets that, as these apertures must be either all round the building, or at least on two opposite sides, the foul air would always escape to leeward only, while the supply of fresh comes necessarily from windward. Moreover, these external wall or cornice outlets are proposed only for chimneyless apartments, and consequently would be general only in warm climates. In ours they would be confined to public buildings.

5thly. If all that has been said would apply to pure "carbonic acid" (as "D." miscalls the foul air), much more will it apply to this refuse as actually constituted. Can "D." be aware how little of that heavy gas it ever contains? It was shown (I think by the late Professor Daniell), that the greatest change the lungs produce on air passing through them, is to convert one-third of its oxygen into carbonic acid. Now a third of the oxygen is about a *fifteenth* of the whole air, and oxygen takes up just three-eighths of its own weight of carbon to become carbonic acid. The addition we make to our breath, therefore (and which from vital renders it poisonous), is simply a little carbon, in no case more than three-eighths of a *fifteenth* (that is, *one fortieth*) of the weight of the said breath. If then, its bulk were increased one-fortieth (or in the same proportion as its weight is increased) it would neither rise nor sink in the atmosphere. Now this amount of expansion would be produced by raising its temperature about  $10^{\circ}$  or  $12^{\circ}$  Fahr. above that of the general atmosphere. Hence, unless the animal temperature  $97^{\circ}$ , exceeded the atmospheric temperature by at least  $10^{\circ}$  or  $12^{\circ}$ , there would be no ascent of breath, and no ventilation except by extraneous force,—by wind, natural or artificial; and those who have lived much within the tropics will confirm this deduction, that when the general temperature approaches within  $10^{\circ}$  or  $12^{\circ}$  of that of the body, that is, when it exceeds  $85^{\circ}$  or  $87^{\circ}$ , there is an entire change in the conditions of comfortable life. There is somewhere about  $85^{\circ}$  a critical temperature at which we feel the difference of one degree above or below it, more than we feel the difference between  $60^{\circ}$  and  $80^{\circ}$ , or between  $90^{\circ}$  and  $109^{\circ}$ . Above  $85^{\circ}$  a perfectly calm air becomes as unendurable as it is, by providential appointment, uncommon and even phenomenal. We become dependent as it were from hour to hour on the constancy of the sea or mountain breezes, because self-ventilation no longer acts even out of doors, and no dwellings

would be habitable which did not give free passage to the winds. While the temperature exceeds  $85^{\circ}$  therefore, the form of ceilings becomes indifferent; but as there are, I believe, no habitable spots where the air, at any season, exceeds this critical point for even a few hours together, there will be no part of the globe where this attention to ceiling-forms becomes unimportant. The warmer the general climate, the more important it becomes, because the feebler becomes the breath's ascensional force.

Hence, in conclusion (without entering on the bearing of sanitary domestic architecture upon the more general and extensive moral question of *bloody or bloodless engineering*, which I hope to show includes much besides this), I think I may say, without riding a hobby too far, that a strict attention to this element of architecture, would no less than *double the extent of man's habitable earth*, by adding to it those millions of square leagues of *intertropical inland plains*, mostly of such inconceivable fertility that their perches are equivalent to our acres, yet hitherto left wildernesses; not from heat (which there is no reason to suppose averages higher than that of the coasts), nor from the failure of those brisk aerial currents which, being excited only by the inequalities of temperature between land and sea, or between highlands and lowlands, are constant only within a few miles of either mountain chains or coasts. For these breezes, we have seen, are only *really* necessary to life in continued heats of above  $85^{\circ}$  (which point is rarely exceeded for more than the hottest part of the day anywhere). In the ordinary equatorial temperatures, between  $75^{\circ}$  and  $85^{\circ}$ , such currents are not naturally necessary, but only rendered so by chance-constructed dwellings; so that by the *substitution of scientific for random architecture*, these vast and exuberantly-teeming regions (which we cannot doubt are included in the "earth" Adam was to "replenish and subdue") would from uninhabitable become habitable. E. L. G.

#### ON PORTABLE FARM BUILDINGS.

SUGGESTED AS A REMEDY, IN SOME DEGREE, FOR THE SCARCITY OF FARM LABOURERS.

On the 24th of July, 1852, a friend wrote for my opinion as to the best plan for a complete set of new farm-buildings, and, as I had reason to suppose that they were to be erected on a farm not yet enclosed, or in any manner fettered by roads or other artificial works, it seemed that, as these would be unusual circumstances, the more caution was necessary to begin in a right manner, because if the best plan was not adopted there would not be the usual and unanswerable excuse of old buildings being in the way.

It seemed obvious that, as the general fault of old plans was, that they did not leave space for adopting all subsequent improvements, it would be desirable to discover, if possible, some new plan that would *expand* and adapt itself to circumstances, so as to admit of future improvements, as well as include all those known when the buildings were first erected.

Each building should be, not only the right thing in itself, so far as knowledge in such matters has advanced, but also so contrived, if possible, that it may be, on each occasion for using it, in the very best place on the farm for economising labour, and whatever else is valuable, so as to obtain the largest value in produce at the smallest cost.

Knowing that some of the best plans hitherto produced have obvious faults of position, when tried by this economical test, and believing it to be almost impossible to fix a whole set of buildings so as to prevent the chance of this being proved by experience, or by improvements in the modes of carrying out agricultural operations, I was forced to the conclusion that to make the buildings *portable*, or removable from one part of a farm to another, would be one of the most likely means, if not the only means, whereby to correct errors of position, and to give room for expanding or contracting the general plan as circumstances might prove to be necessary.

I have known cases in which it was clearly

proved that some of the best farm machinery was worse than useless (leaving the cost of the machinery itself out of the question), because more extra expense was incurred by bringing the farm produce to and taking it from the machinery than the value of the work done by the use of the machinery; but if this machinery had been "portable" it could have been applied with decided advantage.

It may be said, with truth, that portable farm-buildings would be more generally beneficial in the colonies, or in other countries where the land is at present unenclosed and in its natural state; but the same remark would apply more or less to almost every other agricultural improvement, and particularly to all such as relate to railways, tramways, trucks, carriages, and modes of conveyance generally; but as some of the inhabitants of other countries are likely to adopt real improvements whether we do or not, that is a reason why we should apply them so far as they are likely to be beneficial under our circumstances, but no further.

In a case where all was to commence, that is, where there were no roads, fences, gates, ponds, or buildings, it might, but I do not say it always would, be desirable to have all the buildings moveable.

Where the reverse of all this was the case, and the farms were also small and compact, probably there would generally be so much the less necessity for moveable buildings.

Where the farms were large, and the land scattered, or far from the present buildings, it might be good economy to have new and portable buildings for the outlying fields.

In no case should present buildings be pulled down hastily, especially if they are in good repair, and likely to cost little by remaining where they are.

In short, I wish it to be clearly understood that I do not advocate rash and costly changes, or any changes that after due consideration are not likely to be profitable.

If any one doubts the value of having farm-buildings moveable, let him bear in mind what a saving of labour there would be in some cases, by having portable cattle-boxes, &c. take to one end of the farm, instead of bringing the turnips and straw, &c. from that end of the farm and then taking them back again as manure.

Unnecessary labour causes other labour, that would not otherwise be necessary; for instance, unnecessary carting on roads causes labour in repairing them.

By avoiding the first error, and consuming the produce, or part of it, near to where it was grown, the number of operations saved would vary according to circumstances, so I will not attempt to enumerate them; but in some cases the saving in the cost of labour, and in the quality of the corn by harvesting it more rapidly, might be equal to the whole rent of the land.

It may be said that, to do this, the cattle and their "boxes," &c. would want a labourer to look after them; and "where would he live?"

My answer is,—Why should not he live in a portable cottage close by his work, if that would pay the landowner and occupier the best as a means of enabling them to cultivate the land?

When 1,000 men can live in a portable building at sea, surely a labourer, and his wife, if necessary, may be provided with a portable residence on land that would contain more comforts and conveniences than they are accustomed to.

If horses had portable stables close by their work, they would lose less time in going to and from it; therefore they would be able to do more real and necessary work in the same time.

They could be comfortable in the stable close by when not wanted on the land, and what is more, they could be making the best manure by eating a green-crop of lucern, tares, or whatever else was most likely to be profitable to grow close by, and the manure so made would be close by where it was wanted.

I have no doubt it is quite practicable to make every necessary farm-building moveable, and in many cases I am quite certain that it